# GOVERNMENT GOLLEGE FOR WOMEN (AUTONOMOUS) KUMBAKONAM

## DEPARTMENT OF ECONOMICS

## M.A. ECONOMICS

## MICRO ECONOMIC ANALYSIS - 1

**Sub Code : P18ECC101**


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# MODULE – III
# THEORY OF PRODUCTION AND COST

## PRODUCTION FUNCTION: Meaning;

Production is the result of co-operation of four factors of production viz., land, labour, capital and organization.

This is evident from the fact that no single commodity can be produced without the help of any one of these four factors of production.

Therefore, the producer combines all the four factors of production in a technical proportion. The aim of the producer is to maximize his profitThe producer secures the best combination by applying the principles of equi-marginal returns and substitution. For instance, when the marginal product of the land is equal to that of labour, capital and organisation, the production becomes maximum.

# Meaning of Production Function

In simple words, production function refers to the functional relationship between the quantity of a good produced (output) and factors of production (inputs).

"The production function is purely a technical relation which connects factor inputs and output" **-Prof. Koutsoyiannis.**

Production function as "the relation between a firm's physical production (output) and the material factors of production (inputs)" **-Prof. Watson.**

"The production function is a technical or engineering relation between input and output. As long as the natural laws of technology remain unchanged, the production function remains unchanged." **Prof. L.R. Klein**

"Production function is the relationship between inputs of productive services per unit of time and outputs of product per unit of time." **Prof. George J. Stigler**

The new production function brought about by developing technology displays same inputs and more output or the same output with lesser inputs. Sometimes a new production function of the firm may be adverse as it takes more inputs to produce the same output.

Mathematically, such a basic relationship between inputs and outputs may be expressed as:

$$Q = f( L, C, N )$$

Where Q = Quantity of output L = Labour
C = Capital N = Land.

## FEATURES OF PRODUCTION FUNCTION:

- Substitutability
- Complementarity
- Specificity

## PRODUCTION FUNCTION CAN BE CLASSIFIED ON THE BASIS OF THE SUBSTITUTABILITY OF THE INPUTS BY OTHER INPUTS:

- ❖Fixed Proportion Production Function
- ❖Variable Proportion Production Function
- ❖Linear Homogeneous Production Function
- ❖Cobb. Douglas Production Function
- ❖Constant Elasticity of Substitution

## FIXED PROPORTION PRODUCTION FUNCTION

The Fixed Proportion Production Function, also known as a Leontief Production Function implies that fixed factors of production such as land, labor, raw materials are used to produce a fixed quantity of an output and these production factors cannot be substituted for the other factors.

In other words, fixed quantity of inputs is used to produce the fixed quantity of output. All the factors of production are fixed and cannot be substituted for one another.

## VARIABLE PROPORTION PRODUCTION FUNCTION

The Variable Proportion Production Function implies that the ratio in which the factors of production such as labour and capital are used is not fixed, and it is variable. Also, the different combinations of factors can be used to produce the given quantity, thus, one factor can be substituted for the other.

"As the proportion of the factor in a combination of factors is increased after a point, first the marginal and then the average product of that factor will diminish" stated by **Benham**.

According to **Samuelson** "An increase in some inputs relative to other fixed inputs will in a given state of technology cause output to increase, but after a point the extra output resulting from the same additions of extra inputs will become less and less."

## LINEAR HOMOGENEOUS PRODUCTION FUNCTION

The Linear Homogeneous Production Function implies that with the proportionate change in all the factors of production, the output also increases in the same proportion. Such as, if the input factors are doubled the output also gets doubled. This is also known as constant returns to a scale. The production function is said to be homogeneous when the elasticity of substitution is equal to one.

$$nQ = f(nL, nK)$$

When all the inputs are increased in the same proportion, the production function is said to be homogeneous. The degree of production function is equal to one. This is known as linear homogeneous production function. In order to estimate the production function, it is necessary to express the function in explicit functional form. Mathematically, this form of production function is expressed as

This production function also implies constant returns to scale. That is if L and K are increased by n-fold, the output Q also increases by n-fold. This form of production function is a well behaved production function. Which makes the task of the entrepreneur quite simple and convenient? He requires only Finding out just one optimum factor proportions.

# THE COBB-DOUGLAS PRODUCTION FUNCTION

The Cobb-Douglas production function is based on the empirical study of the American manufacturing industry made by Paul **H. Douglas** and **C.W**. **Cobb**. It is a linear homogeneous production function of degree one which takes into account two inputs, labour and capital, for the entire output of the manufacturing industry.

In Cobb-Douglas production function, only two input factors, labor, and capital are taken into the consideration, and the elasticity of substitution is equal to one. It is also assumed that, if any, of the inputs, is zero, the output is also zero.

The Cobb-Douglas production function is expressed as:

$$\mathbf{Q = AL^{a}\ C^{\beta}}$$

where Q is output and L and C are inputs of labour and capital respectively. A, a and β are positive parameters where = a > O, β > O.

# PROPERTIES OF C D PRODUCTION FUNCTION

There are constant returns to scale.

❖Elasticity of substitution is equal to one.

❖A and p represent the labour and capital shares of output respectively.

❖A and p are also elasticities of output with respect to labour and capital respectively.

❖If one of the inputs is zero, output will also be zero.

❖The expansion path generated by C-D function is linear and it passes through the origin.

❖The marginal product of labour is equal to the increase in output when the labour input is increased by one unit.

❖The average product of labour is equal to the ratio between output and labour input.

# MERITS OF C-D PRODUCTION FUNCTION

- It suits to the nature of all industries.
- It is convenient in international and inter-industry comparisons.
- It is the most commonly used function in the field of econometrics.
- It can be fitted to time series analysis and cross section analysis.
- The function can be generalised in the case of ‘n’ factors of production.
- The unknown parameters a and p in the function can be easily computed.
- It becomes linear function in logarithm.
- It is more popular in empirical research.

# LIMITATIONS OF C-D PRODUCTION FUNCTION

- The function includes only two factors and neglects other inputs.
- The function assumes constant returns to scale.
- There is the problem of measurement of capital which takes only the quantity of capital available for production.
- The function assumes perfect competition in the factor market which is unrealistic.
- It does not fit to all industries.
- It is based on the substitutability of factors and neglects complementarity of factors.
- The parameters cannot give proper and correct economic implication

## CES [ Constant Elasticity of Substitution] Production Function

Arrow, Chenery, Minhas and Solow in their new famous paper of 1961 developed the Constant Elasticity of Substitution (CES) function. This function consists of three variables Q, C and L, and three parameters A, and.

It may be expressed in the form:

$$Q = A\,[aC^{-\theta} + (1-\alpha)L^{-\theta}]^{-1/\theta}$$

where Q is the total output, C is capital, and L is labour. A is the efficiency parameter indicating the state of technology and organisational aspects of production.

## The CES production function possesses the following properties

1. The CES function is homogenous of degree one. If we increase the inputs C and L in the CES function by n-fold, output Q will also increase by n-fold. Thus like the Cobb-Douglas production function, the CES function displays constant returns to scale.
2. In the CES production function, the average and marginal products in the variables C and L are homogeneous of degree zero like all linearly homogeneous production functions.
3. From the above property, the slope of an isoquant, i.e., the MRTS of capital for labour can be shown to be convex to the origin.

## The CES function has the following merits:

- ❖CES function is more general.
- ❖CES function covers all types of returns.
- ❖CES function takes account of a number of parameters.
- ❖CES function takes account of raw materials among its inputs.
- ❖CES function is very easy to estimate.
- ❖CES function is free from unrealistic assumptions.

## Limitations of CES Production Function:

- The CES production function considers only two inputs. It can be extended to more than two inputs. But it becomes very difficult and complicated mathematically to use it for more than two inputs.

- The distribution parameter or capital intensity factor coefficient, α is not dimensionless.
- If data are fitted to the CES function, the value of the efficiency parameter A cannot be made independent of 0 or of the units of Q, C and L.
- It suffers from the drawback that elasticity of substitution between any part of inputs is the same which does not appear to be realistic.
- In estimating the parameters of CES production function, we may encounter a large number of problems like choice of exogenous variables, estimation procedure and the problem of multi-collinear ties.
- There is little possibility of identifying the production function under technological change.

# COST THEORY: INTRODUCTION, CONCEPTS

The firm's costs determine its supply. Supply along with demand determines price. To understand the process of price determination and the forces behind supply, we must understand the nature of costs. We study some important concepts of costs, and traditional and modern theories of cost.

## Cost concepts:

Costs are very important in business decision-making. Cost of production provides the floor to pricing. It helps managers to take correct decisions, such as what price to quote, whether to place a particular order for inputs or not whether to abandon or add a product to the existing product line and so on.

Ordinarily, costs refer to the money expenses incurred by a firm in the production process.

# ACCOUNTING AND ECONOMIC COSTS

**Accounting Costs** – this is the monetary outlay for producing a certain good. Accounting costs will include your variable and fixed costs you have to pay. These costs include the following:

Rent, Utility expenses, Food and entertainment expenses, Travel expenses, including transportation and hotels, Payroll expenses, including salaries and related payroll taxes, Supplies, Insurance extra.

**Economic Cost** – Economic cost includes both the actual direct costs (accounting costs) plus the opportunity cost. Economic cost is a broader concept than that of accounting cost. Economic cost includes not only monetary transactions but also what economists term opportunity costs.

# PRODUCTION COSTS

Cost of production is the total price paid for resources used to manufacture a product or create a service to sell to consumers including raw materials, labor, and overhead.

The total costs of production of a firm are divided into total variable costs and total fixed costs. The total variable costs are those expenses of production which change with the change in the firm's output. Larger output requires larger inputs of labour, raw materials, power; fuel, etc. which increase the expenses of production. When output is reduced, variable costs also diminish. They cease when production stops altogether. Marshall called these variable costs as prime costs of production.

# ACTUAL COSTS AND OPPORTUNITY COSTS

**Actual costs** refer to the costs which a firm incurs for acquiring inputs or producing a good and service such as the cost of raw materials, wages, rent, interest, etc.

**Opportunity costs** represent the potential benefits an individual, investor, or business misses out on when choosing one alternative over another. Understanding the potential missed opportunities foregone by choosing one investment over another allows for better decision-making.

## PRIVATE AND SOCIAL COSTS

Private costs are the costs incurred by a firm in producing a commodity or service. These include both explicit and implicit costs. However, the production activities of a firm may lead to economic benefit or harm for others. For example, production of commodities like steel, rubber and chemicals, pollutes the environment which leads to social costs.

Social costs are private costs borne by individuals directly involved in a transaction together with the external costs borne by third parties not directly involved in the transaction. The social cost includes both the private cost and the external cost.

On the other hand, production of such services as education, sanitation services, park facilities, etc. leads to social benefits.

## INCREMENTAL COSTS AND SUNK COSTS

Incremental costs denote the total additional costs associated with the marginal batch of output. These costs are the additions to costs resulting from a change in the nature and level of business activity, e.g., change in product line or output level, adding or replacing a machine, changes in distribution channels, etc.

Sunk costs are the costs that are not affected or altered by a change in the level or nature of business activity. All past or actual costs are regarded as sunk costs. Thus, sunk costs are irrelevant for decision making as they do not vary with the changes expected for future by the management, whereas incremental costs are relevant to the management for business making.

## EXPLICIT COSTS AND IMPLICIT COSTS

Explicit costs are those payments that must be made to the factors hired from outside the control of the firm. Such payments as rent, wages, interest, salaries, payment for raw materials, fuel, power, insurance premium, etc. are examples of explicit costs.

Implicit costs refer to the payments made to the self-owned resources used in production.

# INCREMENTAL COSTS AND MARGINAL COSTS

Incremental cost is the total cost incurred due to an additional unit of product being produced. Incremental cost is calculated by analyzing the additional expenses involved in the production process, such as raw materials, for one additional unit of production.

Marginal cost is the cost of producing an additional unit of output, while incremental cost is defined as the change in cost resulting from a change in business activities.

## Total Costs or TC:

Total costs are the total expenses incurred by a firm in producing a given quantity of a commodity. They include payments for rent, interest, wages, taxes and expenses on raw materials, electricity, water, advertising, etc.

## Total Fixed Costs or TFC:

A fixed cost is a cost that does not change with an increase or decrease in the amount of goods or services produced or sold. Fixed costs are expenses that have to be paid by a company, independent of any specific business activities.They include payments for renting land and buildings, interest or borrowed money, insurance charges, property tax, depreciation, maintenance expenditures, wages and salaries of the permanent staff, etc. They are also called overhead costs.

## Total Variable Costs or TVC:

A variable cost is an expense that rises or falls in direct proportion to production volume. Variable costs differ from fixed costs, which remain the same even as production and sales volume changes.They include expenses on raw materials, power, water, taxes, hiring of labour, advertising etc., They are also known as direct costs.

## Short-Run Average Costs:

In the short run analysis of the firm, average costs are more important than total costs. The units of output that a firm produces do not cost the same amount to the firm. But they must be sold at the same price. Therefore, the firm must know the per unit cost or the average cost. The short-run average costs of a firm are the average fixed costs, the average variable costs, and the average total costs.

## THE MODERN THEORY OF COSTS

The modem theory of costs differs from the traditional theory of costs with regard to the shapes of the cost curves. In the traditional theory, the cost curves are U-shaped. But in the modem theory which is based on empirical evidences, the short-run SAVC curve and the SMC curve coincide with each other and are a horizontal straight line over a wide range of output.

So far as the LAC and LMC curves are concerned, they are L-shaped rather than U-shaped. We discuss below the nature of short- run and long-run cost curves according to the modem theory.

## (A) Short-Run Cost Curves:

As in the traditional theory, the short-run cost curves in the modem theory of costs are the AFC, SAVC, SAC and SMC curves. As usual, they are derived from the total costs which are divided into total fixed costs and total variable costs.

But in the modem theory, the SAVC and SMC curves have a saucer-type shape or bowl- shape rather than a U-shape. As the AFC curve is a rectangular hyperbola, the SAC curve has a U-shape even in the modem version. Economists have investigated on the basis of empirical studies this behaviour pattern of the short-run cost curves.

## (B) Long-Run Cost Curves

Empirical evidence about the long-run average cost curve reveals that the LAC curve is L-shaped rather than U-shaped. In the beginning, the LAC curve rapidly falls but after a point "the curve remains flat, or may slope gently downwards, at its right-hand end." Economists have assigned the following reasons for the L-shape of the LAC curve.

## PRODUCTION AND MANAGERIAL COSTS:

In the long run, all costs being variable, production costs and managerial costs of a firm are taken into account when considering the effect of expansion of output on average costs. As output increases, production costs fall continuously while managerial costs may rise at very large scales of output.

## Production Costs:

As a firm increases its scale of production, its production costs fall steeply in the beginning and then gradually. The is due to the technical economies of large scale production enjoy by the firm.

## Managerial Costs:

In modern firms, for each plant there is a corresponding managerial set-up for its smooth operation. There are various levels of management, each having a separate management technique applicable to a certain range of output.

## ISOQUANT AND ISOCOSTS

1.An isoquant shows all combination of factors that produce a certain output.

2.An isocost show all combinations of factors that cost the same amount.

3. Isocosts and isoquants can show the optimal combination of factors of production to produce the maximum output at minimum cost.

## ISOQUANT CURVE

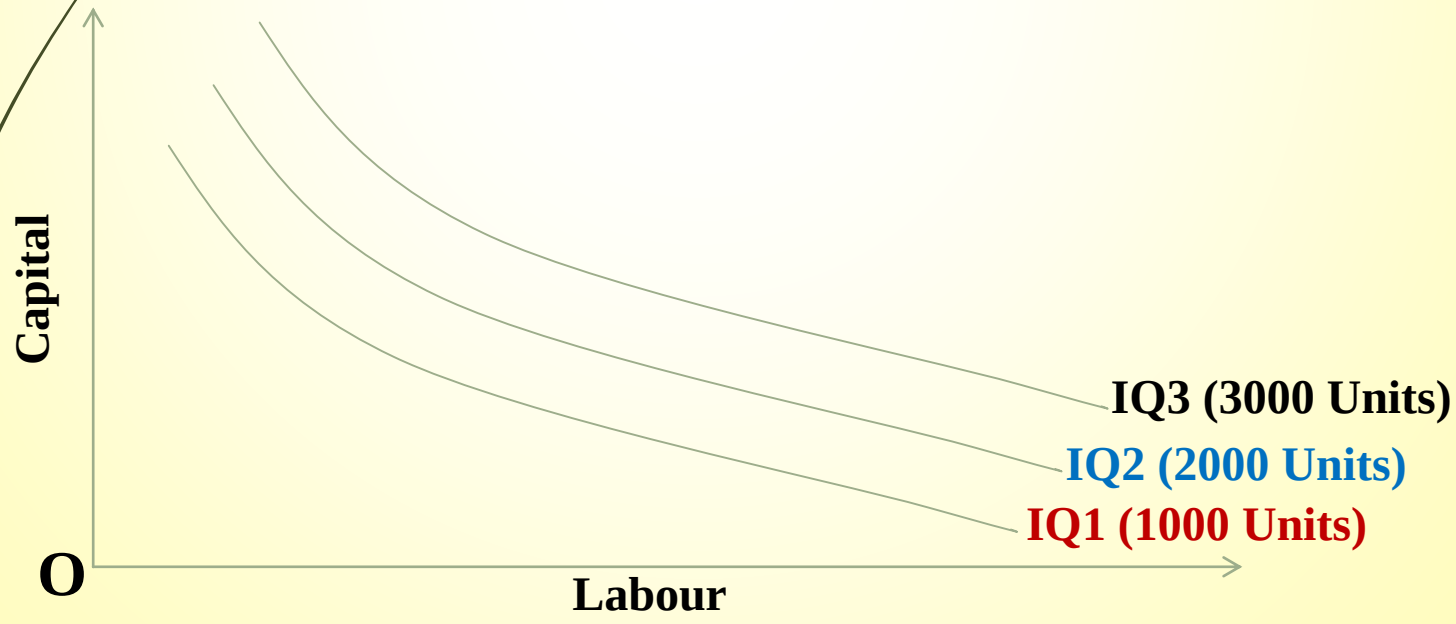
An isoquant shows all the combination of two factors that produce a given output.

An isoquant curve is that convex shaped curve which is formed by joining the points depicting the different blends of the two production factors, providing constant output. Here, the term ‘isoquant’ can be cracked into ‘iso’ which implies equal and ‘quant’ that stands for quantity. The word altogether means the same volume or constant output at all points.

# ISO QUANT MAP

An iso quant map is very similar to an indifference map. It can be formed while producing a higher quantity of products from the various possible combinations of the two factors. It facilitates multiple levels of output.

In the given figure we can assume that 1000 units of a product are produced in IQ1, 2000 units in IQ2 and 3000 units in IQ3:



# ASSUMPTIONS FOR ISOQUANT CURVE

Iso quant curve provides an understanding of how the change in one factor of production affects the other when the output remains constant.

To form an iso quant curve, we have to presume the following:

1.Optimum Combinations: All the possible combinations of the production factors are efficient, yielding the same output and quality.

2.Two Factors of Production: There are only two factors involved in the production function, as we can say that 'Q=f(L, K)'.

3.Steady Production Technique: The production method or technology remains static throughout the process.

4.Technical Substitution Possible: The factors of production should be such that it is possible to substitute one with the other, like labour and capital.

## PROPERTIES OF ISO QUANT CURVE

❖ Convex to the Origin: Since one production factor increases while the other decreases, a convex shaped curve to the origin point, is formed. Another reason for it is the diminishing MRTS.

❖ Right Isoquant Indicates Higher Output than Left Isoquant: When there are more than one isoquant curves on a graph, the upper curve will always indicate a higher output. As in the above isoquant map, IQ2 and IQ3 produce more than IQ1.

❖ Two or More Isoquants May or May Not Be Parallel: As the MRTS of each isoquant curve may vary from one another, two or more isoquant curves don't need to be parallel to each other.

- Negative Slope: To increase the number of units for one factor, the producer has to decrease the units of the other production factor. This principle leads to negative sloping of the isoquant curve.

- Two or More Isoquants Never Intersect: As we already know that on an isoquant map, all the isoquant curves depict a different level of output, we can say that they cannot have any combination of factors in common. Thus, the two curves can never intersect one another.

## ISO-COST LINES

Iso-cost lines represent the prices of factors. An iso-cost line graphically represents all the combinations of the inputs which the firm can achieve with a given budget for production or given outlay.

An isocost line is a locus of points showing the alternative combinations of factors that can be purchased with a fixed amount of money. In fact, every point on a given isocost line represents the same total cost. To construct isocost lines we need information about the market prices of the two factors. For example labour and capital.

## Profit maximization – the least cost method of production

In economics, profit maximization is the short run or long run process by which a firm may determine the price, input, and output levels that lead to the highest profit. Neoclassical economics, currently the mainstream approach to microeconomics, usually models the firm as maximizing profit.

# THANK YOU